



NASA STTR 2011 Phase I Solicitation

T7.01 Ground Effects of Launch Acoustics

Lead Center: KSC

The exhaust plume from a launch vehicle rocket engine generates severe acoustic waves, which cause acoustic loading on the ground structures and vehicle payload. Prediction and reduction of the acoustic levels in the near field of launch vehicle lift-off is an important factor that should be taken into consideration early in the design process of the space launch complex.

The Kennedy Space Center is dedicated for ground systems operation. It is crucial that ground support equipments (GSE) and launch pad structures are designed to withstand the launch-induced environments produced by the first-stage rocket exhaust plume.

High-fidelity prediction technique such as computational aeroacoustics (CAA) can be used to resolve the acoustic flow field in an accurate fashion. It is understood that CAA prediction can be computationally intensive and often prohibitive for a large domain as in the launch environment. However, recent advances in computational resources and methodology have allowed CAA to overcome these difficulties. In the past few years, researchers have employed CAA in the launch environment^{1, 2, 3}. These results are promising, but they need to be validated against actual data. The economical way of getting acoustic data is from static firing in a subscale or full scale environment. The problem with static firing test is that they do not reveal the dynamic environment. Flight data from actual launch would yield much better data, but such data are limited and costly. The best alternative would be to collect data from a demonstration launch vehicle.

It is proposed that a capability be developed to perform launch acoustics research by launching a demonstration reusable vehicle from one of the launch pads at KSC or Cape Canaveral Air Force Station (CCAFS), with acoustic sensors installed on the vehicle and in the vicinity of the launch complex. The capability will allow raw data to be processed into one-third octave band sound pressure level and used for benchmarking results obtained from CAA analysis.

References:

- Tsutsumi, S., Kato, S., Fukuda, K., and Takaki, R., "Effect of Deflector Shape on Acoustic Field of Launch Vehicle at Lift-off", AIAA-2009-3028, 47th AIAA Aerospace Sciences Meeting, Orlando, FL, 5-8 January 2009.

-
- Tsutsumi, S., Kato, S., Fukuda, K., and Takaki, R., "Numerical Study on Acoustic Radiation for Designing Launch-Pad of Advance Solid Rocket," AIAA-2008-5148, 44th AIAA/ASME/SAE/ASEE Joint Propulsion Conference & Exhibit, Hartford, CT, 21-23 July 2008.
 - Casalino, D., Barbarino, M., Genito, M., and Ferrara, V., "Improved Empirical Methods for Rocket Noise Prediction through CAA Computation of Elementary Source Fields, 14th AIAA/CEAS Aeroacoustics Conference, 5-7 May 2008, Vancouver, BC, Canada.